Application Serial No.	:	10/672,390
Filed	:	26 September 2003
Applicant	:	W. Voorhees et al.
Title	:	SYSTEMS AND METHODS FOR CONFIGURING PORTS OF AN SAS DOMAIN
Art Unit	:	2153
Examiner	:	P. J. Chea
Docket Number	:	03-0961
Date	:	13 November 2008

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CORRECTED APPEAL BRIEF

Sir:

Appellants herewith file this Corrected Appeal Brief in support of their Appeal in the above identified matter and in response to the Notice of Non-Compliant Appeal Brief mailed 17 October 2008. The $510 fee under 37 CFR 41.20(b)(2) for the Appeal Brief was previously submitted with the original Appeal Brief mailed 30 September 2008.

TABLE OF CONTENTS

i. REAL PARTY IN INTEREST

The real party in interest is LSI CORPORATION - new corporate name for LSI LOGIC CORPORATION, the employer of the inventor at the time of the invention and the assignee of the patent rights in the above-identified matter. A copy of the corporate resolution changing the name from LSI LOGIC CORPORATION to LSI CORPORATION is attached hereto.

ii. RELATED APPEALS AND INTERFERENCES

No other appeals, interferences, or related applications are known to the Appellants, the Appellants' legal representative, or the Assignee, which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

iii. STATUS OF CLAIMS

Claims 1-12, 14, and 16-20 remain pending, stand rejected, and remain in the application for consideration on appeal. The 35 U.S.C. §103(a) rejection of these claims forms the basis of this appeal. Claims 13 and 15 were previously cancelled.

iv. STATUS OF AMENDMENTS

No amendments have been filed since the last office action (final office action) mailed 9 July 2008.

v. SUMMARY OF THE CLAIMED SUBJECT MATTER

A Serial Attached SCSI (SAS) network (domain) typically comprises one or more SAS initiator devices coupled to one or more SAS target devices via one or more SAS expander devices. In general, as is common in all SCSI communications, SAS initiators initiate communications with SAS targets. The expander devices expand the number of ports of a SAS network domain. The expander devices are often arranged such that the path from any SAS initiator to any particular SAS target may pass through multiple expander devices. In addition, there may exist multiple paths through the network of expanders to establish communications between a particular initiator and a particular target. The expander devices (as well as initiator devices) therefore also include routing tables that enable SAS initiators and SAS devices to route communications through the network of expander devices.

The SAS initiators may also perform as control elements of the network to control and configure the devices of the network for routing information and other attributes. For example, a SAS initiator may require information about a particular SCSI disk drive coupled to an expander device network. The SAS initiator, therefore, sends a SCSI command identifying the desired target device as the ultimate destination for the command. The initiator directs the command to an adjacent expander device of the expander device network. The expander device has routing tables in which it looks for the identified target device and thereby determines the next device along the path to the identified target – perhaps another expander. Each expander similarly consults its routing tables to forward the command further along a path toward the identified target until the intended disk drive target device receives the command. Status information or data generated by the target device to be returned to the initiator is similarly routed through the expander devices until it reaches the appropriate initiator of the SCSI command. Typically, subtractive routing is used to return the response along a path where table routing was used to direct the request. Those skilled in the art will note that table routing is always used in the case of a "fan-out" expander as provided in the SAS specifications.

Prior to commencing normal SAS network domain operations, a topology of the network domain must be identified so that a SAS initiator may correctly configure

routing information to route commands and status through the expander device network. When the SAS network is initialized, a SAS initiator may perform a discovery process that determines the topology of the network domain and configures the routing tables of the expander devices within that domain. Such a discovery process may utilize a Serial Management Protocol (SMP) Report General request and Discover request to determine the topology of the SAS domain (i.e., of the network). SMP protocols and commands are defined in the SAS standards and are used by SAS devices to communicate management information with other SAS devices in a SAS domain. In general, the topology of the network may be determined through the discovery process by a recursive traverse through all expander devices of the SAS domain. An example of such a recursive process is provided in an appendix of the SAS specifications generally available to those of ordinary skill in the art (and publicly available at www.t10.org).

As a preliminary step generally presumed to precede the discovery process, an administrator must set a "routing attribute" associated with each port of a SAS device – in particular the routing attribute needs to be set for each port (also referred to as a Phy) of each expander device. The SAS standards define a "routing attribute" associated with each port that generally indicates the direction of flow through the port as toward target devices or toward initiator devices. "Subtractive routing" as defined in the SAS specification refers to routing between expander devices in a consistent "non-changing" direction through a SAS network domain, such as all routing between expander devices flowing towards a SAS initiator. "Table routing" as defined in the SAS specification refers to routing between expander devices in an opposite direction of subtractive routing. "Direct routing" attribute indicates that the port is coupled directly to a port of an end device (an initiator or target device).

As presently known in the art, configuration of routing attributes of expander device ports or Phys is a manual process performed prior to the discovery process described above for discovering the topology of the SAS domain. When a new SAS domain is initially installed or when an existing SAS domain is altered by addition or subtraction of one or more expanders or other devices, the routing attributes of all ports of all expanders may require re-configuration. While SAS initiators and target devices

typically do not require port route attribute configuration as they are able to configure their respective ports (they are always direct routing), expander devices presently require manual port configuration to associate the subtractive routing attributes and the table routing attributes with ports of the expanders. Since there can be as many as 128 ports or Phys in each SAS device and virtually any number of SAS devices within a single network domain, manually configuring the ports is a tedious and time consuming process and delays operation of the storage network. Further, manual processes for configuring the routing attributes of each port of each device are prone to human errors.

The present invention provides methods and associated structures to automatically configure routing attributes of ports of an SAS network domain. More specifically, one or more domain control elements automatically configure SAS routing attributes of ports for a plurality of expander devices within an SAS network domain such that routing tables of the expander devices can then be automatically formatted. The automated configuration of routing attributes eliminates potential for human error inherent in previous manual processes and reduces delays as compared to such manual processes. The automated methods and structures of the present invention may be embodied within a suitably enhanced SAS initiator device or a suitably enhanced SAS expander of the domain - either operating as a control element.

More specifically, an exemplary embodiment of the invention of claim 1 provides for an automated method of configuring routing attributes of ports within a SAS domain. The method includes automatically discovering devices of the SAS network domain and automatically discovering the ports of the discovered devices (250, 200, 202 of FIG. 2 and page 12 starting at line 26). The method then includes (either following discover processing or integrated with discovery processing) automatically determining and configuring the routing attribute to be associated with each discovered port of the discovered devices (200 of FIG. 2, page 12 starting at line 6; 326 of FIG. 3, page 17 starting at line 12). The method of claim 1 also includes automatically configuring routing table information used by the devices of the domain derived from the configured routing attributes (202 of FIG. 2, page 12, starting at line 11; 320 of FIG. 3, page 16 starting at line 14).

Another exemplary embodiment of the invention as recited in claim 10 provides a SAS network domain comprising a plurality of expander devices each providing a plurality of ports within the domain wherein each port may have an associated routing attribute (102 of FIG. 1, page 7 starting at line 15; E1, E2, and E3 of FIG. 4, page 18 starting at line 11). The SAS domain also includes a domain control element (101 of FIG. 1, page 8 starting at line 4, page 9, starting at line 1 and at line 28) coupled to at least one of the plurality of expander devices operable to configure the routing attributes of the plurality of ports. The domain control element is operable to automatically determine and automatically configure the routing attributes of the ports by traversing port connections between the expander devices. The domain control element is further operable to use the configured routing attributes to automatically generate complete routing tables used by the plurality of expander devices.

Claim 14 reflects yet another exemplary embodiment of the invention. Claim 14 recites means for performing the steps of method claim 1. The structures for performing these functions are the same elements of FIG. 1 as discussed above with respect to claim 10. Specifically a domain control element (101 of FIG. 1, page 8 starting at line 4, page 9, starting at line 1 and at line 28) is an exemplary structure that provides the means for discovering, the means for automatically determining, the means for configuring SAS routing attributes, and the means for configuring routing tables as recited in claim 14.

vi. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 1-12, 14, and 16-20 are unpatentable under 35 U.S.C. §103(a) over Applicants Admitted Prior Art (AAPA) in view of Aguilar et al (US 6,199,137).

vii. ARGUMENT

The Examiner rejected all remaining claims (1-12, 14, and 16-20) as unpatentable over AAPA in view of Aguilar. As regards independent claim 1, the Examiner states in essence that AAPA teaches that all the recited steps are known to be manually performed but fails to teach that such steps may be performed automatically. The Examiner then suggests that Aguilar teaches the disadvantages of manual configuration of an IO device (column 1, lines 39-50). The Examiner further suggests that Aguilar teaches automatically discovering devices and ports, and teaches automatically configuring routing table attributes (column 4, lines 26-49).

Applicants respectfully disagree. First and foremost, Aguilar is not related to the particulars of discovering ports of a SAS domain and automatic determination and configuration of routing attributes of devices in the SAS domain. The routing attributes (as described in the subject application) include directional information about the desired use of a port in the domain (i.e., "subtractive", "table", and "direct" routing attribute values). Determination of these attribute values in prior manual techniques required a human thought process to determine the desired routing for each port. The automated configuring of routing attributes as recited in claim 1 requires no such human input to determine the proper routing attribute values for a port. Rather, the proper value is determined and configured automatically by a SAS device (e.g., a "SAS controller" or "SAS control element") in the SAS domain.

AAPA does not suggest that such a determination of routing attribute values may be automated. Neither does Aguilar teach or reasonably suggest any automated technique to replace such a human determination of the proper routing attribute for a port of a SAS device.

"Routing attributes" are a well defined term in the art of SAS interfaces and protocols. Applicants readily admit that it is generally known (as exhibited by Aguilar) to automate the determination and configuration of some parameters of some devices. But such procedures teach nothing of the specifics required for determining and configuring "routing attributes" as the term is well understood by those of ordinary skill in the art of

SAS devices and protocols. Claim 1 is specifically focused on this novel, non-obvious aspect of automatically determining and configuring "routing attributes" of devices in a SAS domain. The SAS specifications suggest no automated methods of so determining the routing attributes of the expander devices in the SAS domain. Aguilar speaks only in the most general sense about automated configuration of certain parameters of certain types of devices - unrelated to the details of "routing attributes" as specific to SAS domains.

The specification and other claims further clarify that the automated process may include traversing nodes of the SAS domain to determine and configure the routing attributes of each port encountered in the traversal.

The Examiner's response to arguments previously presented notes that Aguilar discusses certain automated configurations of a wide variety of devices and then suggests that:

> Given the wide range of domains that could use the benefit of automatic determination and configuration of routing attributes, the Examiner believes that one of ordinary skill in the art at the time of the invention would have found it obvious to apply Aguilar's teaching of automatic determination and configuration of routing attributes to the Applicants Admitted Prior Art (AAPA) of a SAS domain, in order to avoid tedious manual configuration with the addition of new devices (see Aguilar column 1. lines 39-50).

The Examiner applies the teachings of Aguilar that addressed automated configuration of certain devices (not even networks of devices) to the claimed features of configuring routing attributes of devices in a SAS domain. Nothing in Aguilar speaks to configuration of devices in a SAS domain - a network collection of initiator, target, and expander devices where nearly infinite configurations are possible based on routing attributes of the collection of SAS devices. Routing attributes (as the term is properly understood in the context of claim 1 and SAS domains) are nowhere discussed in Aguilar. The automated configuration features of Aguilar (to whatever extent they are expressed) are inapplicable to the complexity of configuring SAS domains. The richness and complexity of the claimed automated procedures is clear in reference to the complexity of the flowchart of FIG. 3. None of the teachings of Aguilar teach or

reasonably suggest the details of such automated determination and configuration of routing attributes in a SAS domain.

Applicants previously amended claim 1 to clearly recite that the routing attribute values are automatically determined and then configured (also automatically). The Examiner's remarks dismiss this aspect suggesting

> In considering the specific routing attributes that are supposed to be configured (i.e. subtractive, table and direct routing attributes), it is not clearly claimed that the routing attributes are limited to those particular ones and even if they were, AAPA discloses that the SAS standards define routing attributes so it would be obvious to configure the ports in that manner.

Again, "routing attributes" in a SAS domain (as clearly recited in claim 1) may only be reasonably understood to mean "routing attributes" as understood in the SAS specification - well known to those of ordinary skill in the art. Applicants readily admit that these attribute values are well known. Indeed they are defined by the SAS specification. However, whatever automated configurations are suggested by Aguilar, none of them suggest techniques that would apply to automated determination and configuration of SAS routing attributes. AAPA certainly suggests that manual steps for such configuration are well known but suggests no techniques for automating those manual steps.

Further, claim 1 recites that the automatically configured routing tables are used by the devices of the SAS domain. In other words, the automatically configured routing tables are distributed or otherwise shared for use by other devices (e.g., all devices) of the SAS domain. Nothing in AAPA or Aguilar teaches or reasonably suggests the automated sharing or distribution of the automatically configured routing tables such that other devices (e.g., all devices) of the SAS domain share the same routing table information. To the contrary, Aguilar appears to discuss the configuration of a single routing device - not the configuration of routing tables that are then used by other devices (e.g., all devices) of a related domain.

Again, in the Examiner's remarks, this feature of using the routing tables that are automatically configured is dismissed suggesting the claim does not recite such. Claim 1

clearly includes the recitation "automatically configuring routing table information used by the devices of the domain derived from the configured routing attributes". The information automatically configured is recited to be "used" by the devices of the domain. Applicants can imagine no clearer recitation than that the automatically configured information is "used" to indicate that all devices of the domain use the information automatically generated in the routing tables. Inherent in such "use" must be distribution or other forms of sharing the automatically configured routing tables.

Thus nothing in AAPA or Aguilar (or any art of record), considered individually or in any combination, teaches or reasonably suggests the features of claim 1 wherein SAS routing attributes are automatically determined and automatically configured to automatically generate routing tables that are used by multiple devices of the SAS domain. Applicants therefore maintain that claim 1 is allowable over all art of record.

There is no reasonable expectation of success in the suggested modification of AAPA by the teachings of Aguilar. Aguilar's proposed automated configurations are simply inapplicable to the complexities of automated determination and configuration of "routing attributes" as the term is properly understood in relation to SAS standards.

Independent claims 10 and 14 include similar recitations and were rejected for similar reasons. Applicants thus maintain that claims 10 and 14 are allowable for at least the same reasons as discussed above with respect to claim 1. Dependent claims 2-9, 11-12, and 16-20 include additional limitations and thus are maintained to be allowable for at least the same reasons as discussed above and as dependent from allowable base claims. In view of the above discussion, Applicants respectfully request reversal of the rejection of all claims under §103 and passage of the application to allowance.

viii. CLAIMS APPENDIX

1. An automated method of configuring routing attributes of ports within a SAS network domain, comprising:

automatically discovering devices of the SAS network domain;

automatically discovering the ports of the discovered devices;

automatically determining the routing attribute to be associated with each discovered port of the discovered devices;

automatically configuring the routing attributes of the discovered ports; and

automatically configuring routing table information used by the devices of the domain derived from the configured routing attributes.

2. The method of claim 1 wherein the steps of discovering devices, discovering ports, and configuring the routing attributes of the discovered ports each include a step of exchanging SMP messages.

3. The method of claim 2 wherein the step of configuring routing table information further comprises:

configuring routing table information within initiator and expander devices of said devices of the SAS network domain wherein said routing table information is sufficient to identify paths in the SAS network domain to enable the exchange of said SMP messages.

4. The method of claim 2 wherein the step of configuring routing table information further comprises:

completely configuring routing table information to identify all paths for exchange of messages within the SAS network domain.

5. The method of claim 4 wherein the step of completely configuring is integrated with the steps of discovering devices, discovering ports, and configuring ports.

6. The method of claim 1 wherein the step of discovering said devices further comprises:

transmitting an SMP Discover request from a first device to a neighboring device of the first device; and

receiving an SMP Discover response in said first device from said neighboring device identifying other devices coupled to ports of said neighboring device.

7. The method of claim 1 wherein the step of discovering said ports of said discovered devices further comprises:

transmitting an SMP Report General request from a first device to a neighboring device of the first device; and

receiving an SMP Report General response in said first device from said neighboring device identifying the number of said ports within said neighboring device.

8. The method of claim 1 wherein the step of configuring further comprises:

transmitting an SMP request from a first device to a second device wherein the SMP request includes vendor unique information identifying a routing attribute of said routing attributes to be configured for a port of said ports of said second device.

9. The method of claim 1 further comprising:

recursively repeating the steps of the method to traverse devices of the SAS network domain to configure said routing attributes of said ports of said devices of the SAS network domain.

10. A SAS network domain, comprising:

a plurality of expander devices providing a plurality of ports within the domain wherein each port may have an associated routing attribute; and

a domain control element coupled to at least one of the plurality of expander devices operable to configure the routing attributes of the plurality of ports, wherein the domain control element is operable to automatically determine and automatically configure the routing attributes of the ports by traversing port connections between the expander devices and wherein the domain control element is further operable to use the configured routing attributes to automatically generate complete routing tables used by the plurality of expander devices.

11. The SAS network domain of claim 10 wherein the domain control element comprises:

a SAS initiator device coupled to at least one of the plurality of expander devices.

12. The SAS network domain of claim 10 wherein the domain control element comprises:

a SAS expander device coupled to at least one of the plurality of expander devices.

13. (Cancelled)

14. A SAS network domain comprising:

means for discovering the topology of the SAS network domain by traversing port connections between devices of the domain;

means for automatically determining the routing attribute to be associated with each discovered port of the discovered devices;

means for configuring SAS routing attributes associated with ports of devices of the domain in response to discovery of the topology of the domain; and

means for configuring routing tables using the configured routing attributes, the routing tables used by the devices of the domain.

15. (Cancelled)

16. The SAS network domain of claim 14 wherein said means for configuring routing tables, said means for discovering and said means for configuring SAS routing attributes are integrated so as to traverse the port connection between the devices of the domain only once.

17. The SAS network domain of claim 14 wherein the means for discovering the topology further comprises:

means for exchanging SMP messages between the devices of the domain to identify the devices, to identify the ports of the devices and to identify the port connections between the ports of the devices.

18. The SAS network domain of claim 17 wherein the means for exchanging SMP messages further comprises:

means for exchanging SMP Report General request and response messages to identify ports of devices and to identify the port connections between the ports of the devices.

19. The SAS network domain of claim 17 wherein the means for exchanging SMP messages further comprises:

means for exchanging SMP Discover request and response messages between the devices of the domain.

20. The SAS network domain of claim 14 wherein the means for configuring further comprises:

means for transmitting an SMP message having vendor unique information from a first device to a second device to instruct the second device to configure the routing attribute of a port of the second device.

xi. EVIDENCE APPENDIX

Included are copies of the evidence relied upon by the Examiner as to the grounds of the rejections under 35 U.S.C. §103(a) to be reviewed on appeal.

1. Subject application as originally filed (cited by the Examiner as Applicants Admitted Prior Art). (34 sheets)

2. Aguilar et al. (United States Patent 6,199,137). (10 sheets)

3. Evidence of change of name of party in interest from LSI Logic to LSI Corporation. (5 sheets)

x. RELATED PROCEEDINGS APPENDIX

None.

SUMMARY

Appellants argue that the Examiner's rejections of claims 1-12, 14, and 16-20 under 35 U.S.C. §103(a) are inadequate as a matter of law and should be reversed. It is believed that this Appeal Brief has been timely filed. However, if an extension of time is deemed to be required by the Patent Office, the Patent Office is hereby requested to accept this request as a petition for an appropriate extension of time to respond with any requisite fees therefore being charged to deposit account 12-2252.

Respectfully submitted,

/Daniel N. Fishman/
Daniel N. Fishman #35,512
Duft, Bornsen & Fishman, LLP
1526 Spruce St.
Suite 302
Boulder, CO 80302
(303) 786-7687
(303) 786-7691 (fax)